



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/755,389	01/05/2001	Sanjeev Banerjia	10990960-1	5215

7590 12/22/2003
HEWLETT-PACKARD COMPANY
Intellectual Property Administration
P.O. Box 272400
Fort Collins, CO 80527-2400

EXAMINER

FOWLKES, ANDRE R

ART UNIT	PAPER NUMBER
----------	--------------

2122

DATE MAILED: 12/22/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/755,389

Applicant(s)

BANERJIA ET AL.

Examiner

Andre R. Fowlkes

Art Unit

2122

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 20 August 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-23 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 05 January 2001 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 4. 6) ☐ Other: _____

DETAILED ACTION

1. Claims 1-23 are pending.

Drawings

2. Figure 1 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Figure 2, should include the label "no" on the arrow pointing from block 106 to block 112.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-4, 6, 8-16, and 18-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ronstrom, U.S. Patent Application Publication No. 2001/0013087 in view of Bala, U.S. Patent No. 6,351,844.

As per claim 1, Ronstrom discloses:

- storing a plurality of data in a cold partition in a cache

memory (§ 24 lines 10-12, “‘hot’ data objects can be collected together in a ‘hot’ memory region (of the cache) and ‘cold’ data does not stay longer in the page cache than needed”, and since the hot data is stored together in a hot region, the cold data is stored together in a cold region).

- **determining whether data that has been stored in the cold partition is hot** (§ 24 lines 1-4, “the read ... access frequency is determined on a data object level. Therefore, it can be decided when a data object should be moved to a ‘hotter’ data storage region”).

- **moving the data to a hot partition in the cache memory when the data has been determined to be hot** (§ 24 lines 1-4, “the read ... access frequency is determined on a data object level. Therefore, it can be decided when a data object should be moved to a ‘hotter’ data storage region”).

Ronstrom doesn't explicitly disclose a **method for operating a code cache in a dynamic instruction translator**.

However, Bala, in an analogous environment discloses a **method for operating a code cache in a dynamic instruction translator** (col. 1 lines 7-8, “This invention relates generally to the selection of code regions for caching in (a) caching dynamic translator).

Therefore, it would have been obvious to a person of ordinary skill in the art, at the time the invention was made, to incorporate the teachings of Bala into the system of Ronstrom to have a method for operating a code cache in a dynamic instruction translator. The modification would have been obvious because one of ordinary skill in

the art would want to increase the performance of a caching dynamic instruction translator by using a performance enhancing caching technique.

As per claim 2, the rejection of claim 1 is incorporated and further Ronstrom discloses that determining whether data is hot comprises:

- **maintaining a different associated counter for each of a plurality of data in the cold partition of the cache memory** (¶ 24 lines 2-3, "access frequency is determined on a data object level").

- **incrementing or decrementing the count in the associated counter each time its associated data is used** (¶ 24 lines 1-3, "the read ... frequency is determined on a data object").

- **and concluding the determination that the data is hot if the count in the associated counter reaches a first threshold value** (¶ 23 lines 18-20, describe "writing data objects whose determined access frequency (count) falls in a predetermined access frequency range (threshold) in data regions belonging to the same data storage section").

As per claim 3, the rejection of claim 1 is incorporated and further Ronstrom discloses that the **hot partition is contiguous and disjoint from the warm partition in said cache memory** (figure 2 shows an example of Ronstrom's technique used to separate the cache into three contiguous and disjoint regions).

As per claim 4, the rejection of claim 2 is incorporated and further Ronstrom doesn't explicitly disclose **maintaining counters in a data structure external to said cache**.

However, Bala, in an analogous environment, discloses **maintaining counters in a data structure external to said cache** (col. 3 lines 30-32, "A trace buffer is provided which is configured to receive and store the branch history data for a series of traces", and figure 2 shows that the trace buffer is external to the code cache).

Therefore, it would have been obvious to a person of ordinary skill in the art, at the time the invention was made, to incorporate the teachings of Bala into the system of Ronstrom to have the counters maintained in a data structure that is external to the cache. The modification would have been obvious because one of ordinary skill in the art would want to maximize the amount of space in the cache that can be used for storing translations.

As per claim 6, the rejection of claim 2 is incorporated and further Ronstrom discloses **maintaining within said cache memory an associated counter step comprises maintaining one of said associated counters for each data object** (§ 24 lines 2-3, "access frequency is determined on a data object level").

As per claim 8, the rejection of claim 2 is incorporated and further Ronstrom discloses **maintaining one of said associated counters for each machine cache line in an associated microprocessor** (§ 24 lines 2-3, "access frequency is determined on a data object (memory block or machine line) level").

As per claim 9, the rejection of claim 2 is incorporated and further Ronstrom discloses **sampling a plurality of said associated counters on an intermittent basis to determine if the count therein has reached said threshold value** (§ 23 lines 18-20, describe “writing data objects whose determined (sampled) access frequency (count) falls in a predetermined access frequency range (threshold) in data regions belonging to the same data storage section”).

As per claim 10, the rejection of claim 1 is incorporated and further Ronstrom discloses **determining if a number of hot data in said hot partition of said cache memory exceeds a second threshold value; and if said number of said hot data exceeds said second threshold value, then expanding the size of said hot partition in said cache memory by adding thereto an expansion area contiguous to said hot partition** (§ 25 lines 1-4, “the access frequencies (threshold) of an access frequency range of an (i+1)-th data storage section (the expanded cache memory region) are greater than the access frequencies of an i-th data storage section (the hot cache region)”, and figure 2 shows Ronstrom’s cold, warm and hot cache partitions. Ronstrom’s warm and cold partitions are analogous to the applicants hot and cold partitions. When a number of warm (hot) data items exceed a second threshold, the space used to cache data items effectively increases and allows data items to be stored in the hot (expanded and contiguous) region of the cache memory).

As per claim 12, the rejection of claim 2 is incorporated and further Ronstrom discloses **maintaining an associated counter for the data in the cache memory** (§ 24 lines 2-3, “access frequency is determined on a data object level”).

As per claim 13, Ronstrom discloses **a cache memory, a cold partition and a hot partition in said cache memory** (figure 2 shows the hot and cold partitions in the cache memory), **logic for determining whether a data that has been stored in the cold partition is hot; and logic for moving the translation to a hot partition in the cache memory when a translation has been determined to be hot** (¶ 24 lines 1-4, "the read ... access frequency is determined on a data object level. Therefore, it can be decided when a data object should be moved to a 'hotter' data storage region").

Ronstrom fails to disclose a **system for a code cache in a dynamic instruction translator**.

However, Bala, in an analogous environment discloses a **system for a code cache in a dynamic instruction translator** (col. 1 lines 7-8, "This invention relates generally to the selection of code regions for caching in (a) caching dynamic translator).

Therefore, it would have been obvious to a person of ordinary skill in the art, at the time the invention was made, to incorporate the teachings of Bala into the system of Ronstrom to have a system for a code cache in a dynamic instruction translator. The modification would have been obvious because one of ordinary skill in the art would want to increase the performance of a caching dynamic instruction translator by using a performance enhancing caching technique.

As per claim 14, the rejection of claim 13 is incorporated, and further claim 14 is a system claim corresponding to claim 2 and is rejected for the reasons set forth in the rejection of claim 2.

As per claim 15, the rejection of claim 13 is incorporated, and further claim 15 is a system claim corresponding to claim 3 and is rejected for the reasons set forth in the rejection of claim 3.

As per claim 16, the rejection of claim 14 is incorporated, and further claim 16 is a system claim corresponding to claim 4 and is rejected for the reasons set forth in the rejection of claim 4.

As per claim 18, the rejection of claim 13 is incorporated, and further claim 18 is a system claim corresponding to claim 6 and is rejected for the reasons set forth in the rejection of claim 6.

As per claim 19, the rejection of claim 13 is incorporated, and further claim 19 is a system claim corresponding to claim 9 and is rejected for the reasons set forth in the rejection of claim 9.

As per claim 20, the rejection of claim 13 is incorporated, and further claim 20 is a system claim corresponding to claim 10 and is rejected for the reasons set forth in the rejection of claim 10.

As per claim 21, the rejection of claim 20 is incorporated, and further claim 21 is a system claim corresponding to claim 11 and is rejected for the reasons set forth in the rejection of claim 11.

As per claim 22, the rejection of claim 13 is incorporated, and further claim 22 is a system claim corresponding to claim 12 and is rejected for the reasons set forth in the rejection of claim 12.

As per claim 23, Ronstrom discloses:

- **a program product, comprising a computer usable medium** (claim 14 lines 3-4, "said ... file content part (program product) is located in main memory), **having computer readable program code embodied therein for directing a computer to manage a cache memory** (§ 6 lines 11-12, "A variety of cache replacement algorithms are used"),

- **storing a plurality of data in a cold partition in a cache memory** (§ 24 lines 10-12, "'hot' data objects can be collected together in a 'hot' memory region (of the cache) and 'cold' data does not stay longer in the page cache than needed", and since the hot data is stored together in a hot region, the cold data is stored together in a cold region).

- **determining whether data that has been stored in the cold partition is hot** (§ 24 lines 1-4, "the read ... access frequency is determined on a data object level. Therefore, it can be decided when a data object should be moved to a 'hotter' data storage region").

- **moving the data to a hot partition in the cache memory when a translation has been determined to be hot** (§ 24 lines 1-4, "the read ... access frequency is determined on a data object level. Therefore, it can be decided when a data object should be moved to a 'hotter' data storage region").

4. Claims 5, 7, and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ronstrom, U.S. Patent Application Publication No. 2001/0013087 in view of Bala,

U.S. Patent No. 6,351,844 in further view of Chilimbi et al. (Chilimbi), U.S. Patent No. 6,330,556.

As per claim 5, the rejection of claim 4 is incorporated and further the combination of Ronstrom and Bala doesn't explicitly disclose **the step of at least temporarily delinking blocks of translations stored in said cold partition so that control exits the cache memory in order to perform the incrementing or decrementing step.**

However, Chilimbi, in an analogous environment, discloses **the step of at least temporarily delinking blocks of translations stored in said cold partition so that control exits the cache memory in order to perform the incrementing or decrementing step** (col. 2 lines 35-36, "Data structures (blocks) are partitioned (delinked and accounted for) into heavily referenced and less heavily references partitions").

Therefore, it would have been obvious to a person of ordinary skill in the art, at the time the invention was made, to incorporate the teachings of Chilimbi into the combined system of Ronstrom and Bala to include the step of at least temporarily delinking blocks of translations stored in said cold partition so that control exits the cache memory in order to perform the incrementing or decrementing step. The modification would have been obvious because one of ordinary skill in the art would be motivated to achieve a greater amount of cache hits by delinking and storing only the most used blocks of translations in the cache.

As per claim 7, the rejection of claim 2 is incorporated and further, the combination of Ronstrom and Bala doesn't explicitly disclose **maintaining an associated counter step comprises logically embedding update code on an arc between two translations.**

However, Chilimbi, in an analogous environment, discloses **maintaining an associated counter step comprises logically embedding update code on an arc between two translations** (abstract lines 1-7, "Nodes in the graph represent fields (individual data elements or translations), and edges between the nodes are weighted to indicate field affinity (the number of times that a translation is accessed)").

Therefore, it would have been obvious to a person of ordinary skill in the art, at the time the invention was made, to incorporate the teachings of Chilimbi into the combined system of Ronstrom and Bala to have an associated counter step that comprises logically embedding update code on an arc between two translations. The modification would have been obvious because one of ordinary skill in the art would want maintain accurate translation access frequency counts to achieve a greater amount of cache hits in order to use the cache in its most effective manner.

As per claim 17, the rejection of claim 16 is incorporated, and further claim 17 is a system claim corresponding to claim 5 and is rejected for the reasons set forth in the rejection of claim 5.

5. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ronstrom, U.S. Patent Application Publication No. 2001/0013087 in view of Bala, U.S. Patent No. 6,351,844 in further view of Walls, U.S. Patent No. 5,675,790.

As per claim 11, the rejection of claim 10 is incorporated and further the combination of Ronstrom and Bala does not explicitly disclose **removing all cold translations from said expansion area and storing said removed translations in said cold partition.**

However, Walls, in an analogous environment, discloses **removing all less-desirable data entries from a dynamic memory area and storing said removed data in a separate location** (col. 8 lines 36-39, "If the segment (data) is smaller than the minimum size (less-desirable) then remove the segment from the (section of) dynamic memory ... (and) insert the segment into a separate (location)").

Therefore, it would have been obvious to a person of ordinary skill in the art, at the time the invention was made, to incorporate the teachings of Walls into the combined system of Ronstrom and Bala to enable **removing all cold translations from said expansion area and storing said removed translations in said cold partition.** The modification would have been obvious because one of ordinary skill in the art would want to maintain the temporal access advantages by keeping the less-desirable data items together and separate from both the most and least desirable data items.

Art Unit: 2122

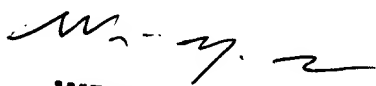
Conclusion

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Andre R. Fowlkes whose telephone number is (703)305-8889. The examiner can normally be reached on Monday - Friday, 8:00am-4:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tuan Q. Dam can be reached on (703)305-4552. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703)305-3900.

ARF


WEI Y. ZHEN
PRIMARY PATENT EXAMINER